

Intel[®] 3100 Chipset

Thermal Design Guide

February 2008



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Revision History

Date	Revision	Description
June 2006	001	Initial public release.
October 2006	002	Updated Table 3 for support of 533 MHz and 667 MHz Bus Speed.
April 2007	003	Added Section 4.3, "Maximum Allowable Static Force" on page 15.
February 2008	004	<ul style="list-style-type: none">Added 800MHz FSB TDP column in Table 3, "Intel® 3100 Chipset Thermal Design Power (TDP)" on page 13Added substrate thickness dimension in Figure 4, "Package Dimensions (Detailed Side View)" on page 10.

1.0 Introduction

The power dissipation of electronic components has risen along with the increase in complexity of computer systems. To ensure quality, reliability, and performance goals are met over the product's life cycle, the heat generated by the device must be properly dissipated. Typical methods to improve heat dissipation include selective use of airflow ducting and/or the use of heat sinks.

The goals of this document are to:

- Specify the thermal and mechanical specification for the Intel® 3100 Chipset.
- Describe a reference thermal solution that meets the specifications.

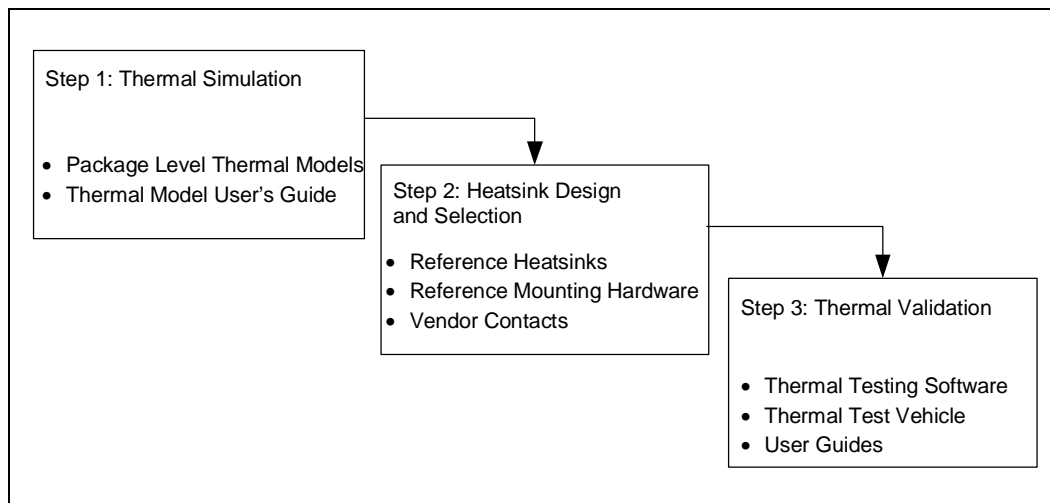
A properly designed thermal solution adequately cools the device die temperature at or below the thermal specification. This is accomplished by providing a suitable local-ambient temperature, ensuring adequate local airflow, and minimizing the die to local-ambient thermal resistance. Operation outside the functional limits can degrade system performance and may cause permanent changes in the operating characteristics of the component.

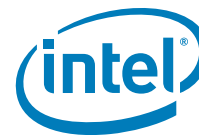
This document addresses thermal and mechanical design specifications for Intel® 3100 Chipset only. For thermal design information on other Intel® components, refer to the respective component datasheet.

1.1 Design Flow

Several tools are available from Intel to assist in the development of a reliable, cost-effective thermal solution. Figure 1 illustrates a typical thermal solution design process with available tools noted. The tools are available through your local Intel field sales representative.

Figure 1. Thermal Design Process





1.2 Definition of Terms

Table 1. Definition of Terms

Term	Definition
FCBGA	Flip Chip Ball Grid Array. A package type defined by a plastic substrate where a die is mounted using an underfill C4 (Controlled Collapse Chip Connection) attach style. The primary electrical interface is an array of solder balls attached to the substrate opposite the die. Note that the device arrives at the customer with solder balls attached.
Intel® 3100 Chipset	Memory and I/O Controller Hub. An integrated chip that contains the processor interface, the memory interface, and the I/O controller hub.
T_{CASE}	Maximum allowed component temperature. This temperature is measured at the geometric center of the top of the package die. Also referred to as T_C .
TDP	Thermal Design Power. Thermal solutions should be designed to dissipate this target power level.
TIM	Thermal Interface Material: thermally conductive material installed between two surfaces to improve heat transfer and reduce interface contact resistance.
T_{LA}	Local ambient temperature. This is the temperature measured inside the chassis, approximately 1" upstream of a component passive heat sink. Also referred to as T_A .
Ψ_{CA}	Case-to-ambient thermal characterization parameter. A measure of the thermal solution thermal performance including the TIM using total package power. Defined as $(T_{CASE} - T_{LA}) / \text{Total Package Power}$. Note: Heat source must be specified when using Ψ calculations.
Ψ_{CS}	Case-to-Sink thermal characterization parameter. A measure of the thermal interface material performance using total package power. Defined as $(T_{CASE} - T_{SINK}) / \text{Total Package Power}$. Note: Heat source must be specified when using Ψ calculations.
Ψ_{SA}	Sink-to-Ambient thermal characterization parameter. A measure of the heat sink performance using total package power. Defined as $(T_{SINK} - T_{LA}) / \text{Total Package Power}$. Note: Heat source must be specified when using Ψ calculations.

1.3 Reference Documents

The reader of this specification should also be familiar with material and concepts presented in the following documents:

- Intel® 3100 Chipset Datasheet

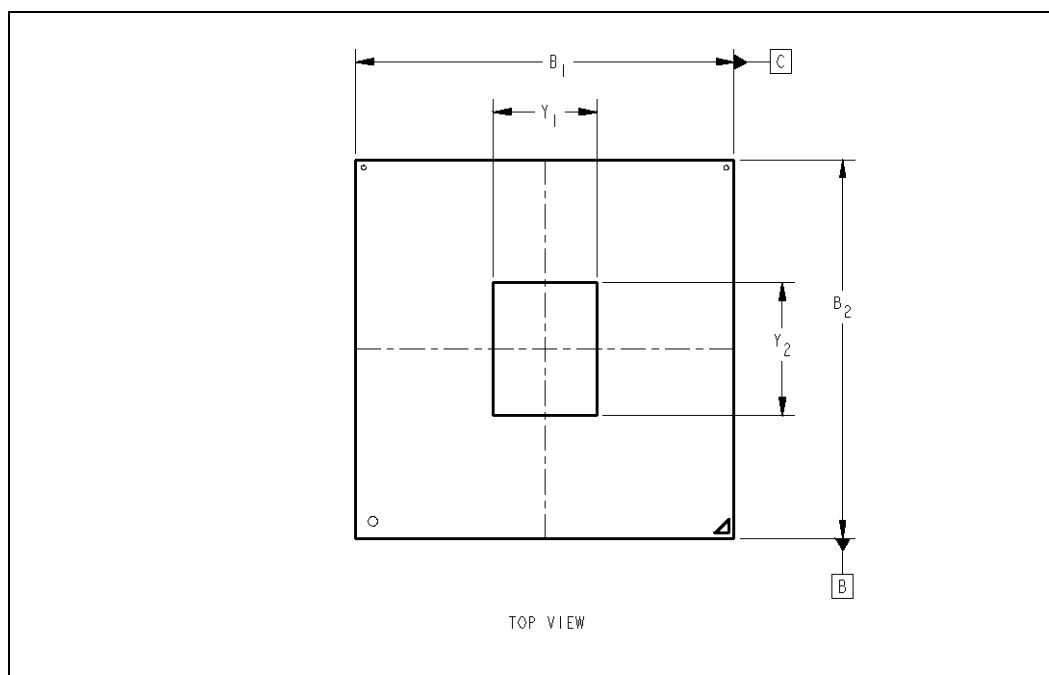
1.4 Thermal Model Availability

Intel provides thermal simulation models of the device and a thermal model user's guide to aid designers in simulating, analyzing, and optimizing thermal solutions in an integrated, system-level environment. The models are for use with commercially available Computational Fluid Dynamics (CFD)-based thermal analysis tools including Flotherm* (version 3.1 or higher) by Flomerics, Inc. or Icepak* by Fluent, Inc. Contact your Intel representative to order the thermal models and associated user's guides.

2.0 Package Information

The Intel® 3100 Chipset utilizes a 1284-ball, 40 x 40 mm, 10-layer FCBGA package. See [Figure 2](#), [Figure 3](#), [Figure 4](#), and [Figure 5](#). The data is provided for reference only. Refer to the device's most recent datasheet for up-to-date data. In the event of conflict, the device's datasheet supersedes data shown in the figures below. The package dimension information is shown in the following figures with the dimensions listed in [Table 2](#) on page 12.

Figure 2. Package Dimensions (Top View)



Notes:

1. Dimensions are in millimeters [inches].
2. Refer to [Table 2](#) for dimensions



Figure 3. Intel® 3100 Chipset Package (Side View)

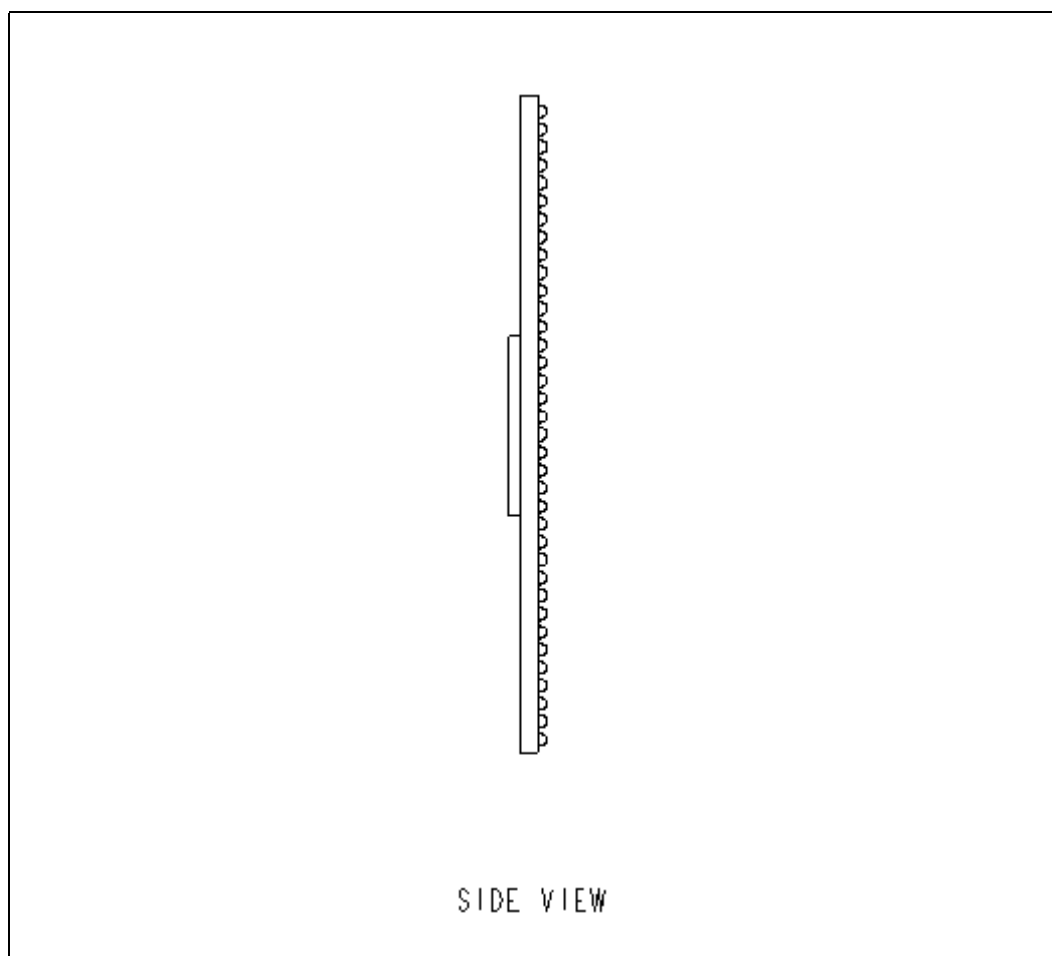
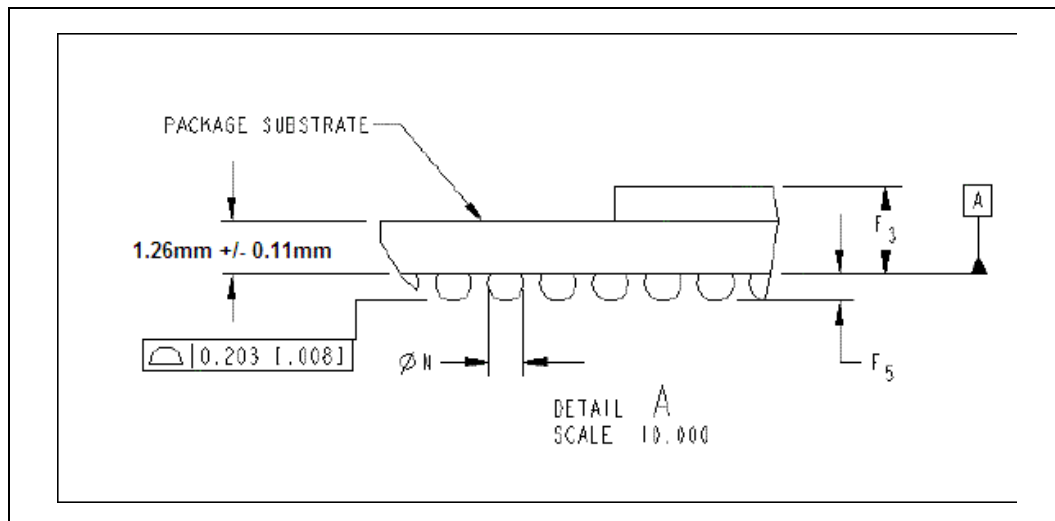


Figure 4. Package Dimensions (Detailed Side View)

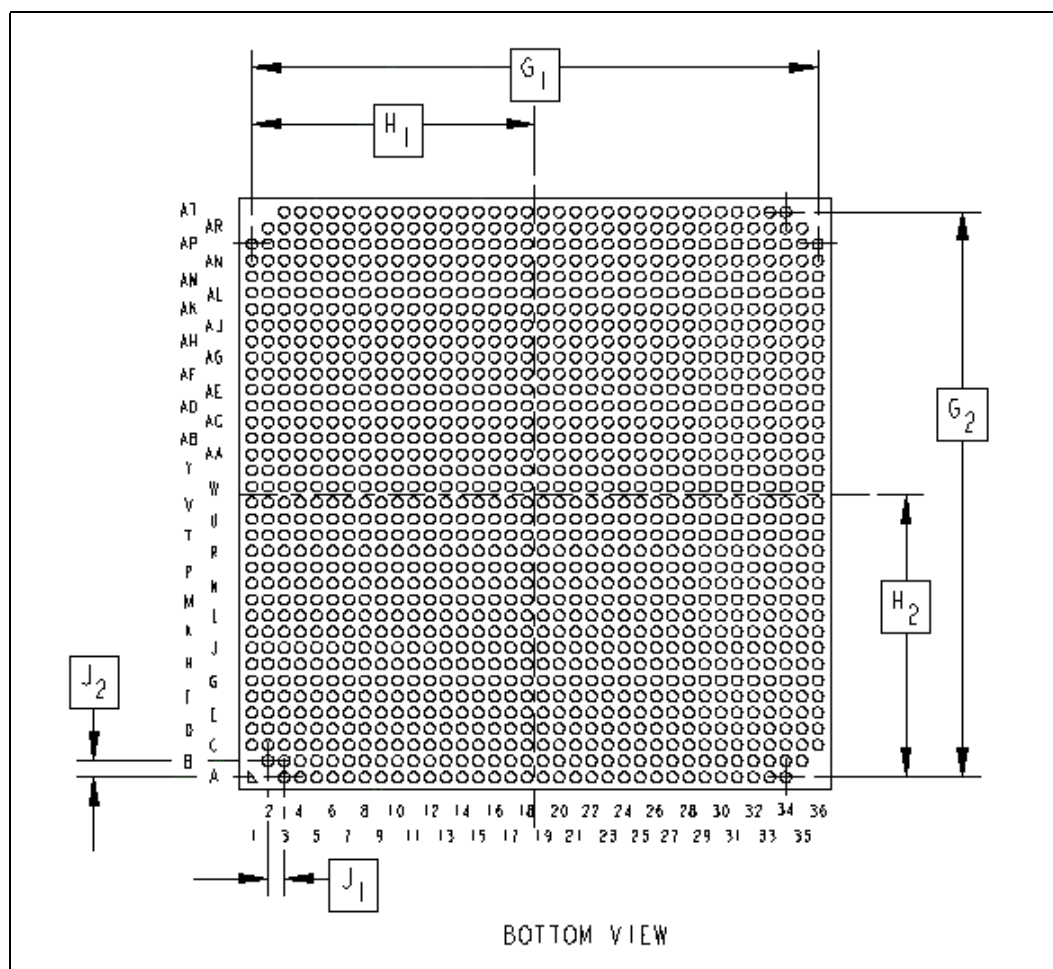


Notes:

1. Dimensions are in millimeters [inches].
2. Refer to [Table 2](#) for dimensions.



Figure 5. Package Dimensions (Bottom View)



Notes:

1. Dimensions are in millimeters [inches].
2. Refer to [Table 2](#) for dimensions.

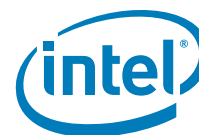


Table 2. Intel® 3100 Chipset Package Dimensions

SYMBOL	MILLIMETERS [INCHES]		COMMENTS
	MIN	MAX	
B ₁	39.95 [1.573]	40.05 [1.578]	
B ₂	39.95 [1.573]	40.05 [1.578]	
F ₃	1.94 .076	2.26 .089	
F ₅	0.4 [.016]	0.6 [.024]	
G ₁	38.22 BASIC [1.505]		<div><div><div><div><div></div></div></div><div><div><div></div></div></div></div><div>Ø0.203 [.008]</div><div>A</div><div>B</div><div>C</div></div>
G ₂	38.22 BASIC [1.505]		
H ₁	19.11 BASIC [.752]		
H ₂	19.11 BASIC [.752]		
J ₁	1.092 BASIC [.043]		
J ₂	1.092 BASIC [.043]		
N	0.61 BASIC [.024]		
Y ₁	11 BASIC [.433]		
Y ₂	14 BASIC [.551]		

Notes:

1. Dimensions are in millimeters [inches].



3.0 Thermal Specifications

3.1 Thermal Design Power

The thermal design power (TDP) specifications are listed in [Table 3](#). Heat transfer through the FCBGA package and into the base board is limited. The cooling capacity without a thermal solution is also limited, so Intel recommends the use of a heat sink for all usage conditions.

The TDP specifications listed in [Table 3](#) are based on four system configurations. These configurations are a combination of features being used in the chipset. The configurations for the Intel® 3100 Chipset are listed below.

- Configuration 1: 4 Ranks DDR2 400, 4 USB ports, 4 SATA drives, 2 PCI ports, 2 x4 PCI Express* ports (north bridge), and 4 x1 PCI Express ports (south bridge)
- Configuration 2: 4 Ranks DDR2 400, 2 USB ports, 3 SATA drives, 1 PCI port, 2 x4 PCI Express* ports (north bridge)
- Configuration 3: 2 Ranks DDR2 400, 2 USB ports, 1 SATA drives, 1 x4 PCI Express* port (south bridge)
- Configuration 4: 1 Rank DDR2 400, 1 USB, 1 SATA drive, 1 x1 PCI Express* port (south bridge)

Table 3. Intel® 3100 Chipset Thermal Design Power (TDP)

	400 MHz Bus Speed	533 MHz Bus Speed	667 MHz Bus Speed	800 MHz Bus Speed
Configuration 1	12.2 W	12.4 W	12.4 W	12.5 W
Configuration 2	11.2 W	11.6 W	11.8 W	12.1 W
Configuration 3	10.6 W	10.8 W	11.2 W	11.4 W
Configuration 4	10.4 W	10.7 W	10.9 W	11.2 W

3.2 Maximum Allowed Component Temperature

The Intel® 3100 Chipset must maintain a maximum temperature at or below the value specified in [Table 4](#) to ensure proper functionality and reliability. The thermal solution is required to meet the temperature specification while dissipating the TDP. [Section 7.0](#) includes guidelines for accurately measuring the package temperature.

Table 4. Temperature Specifications

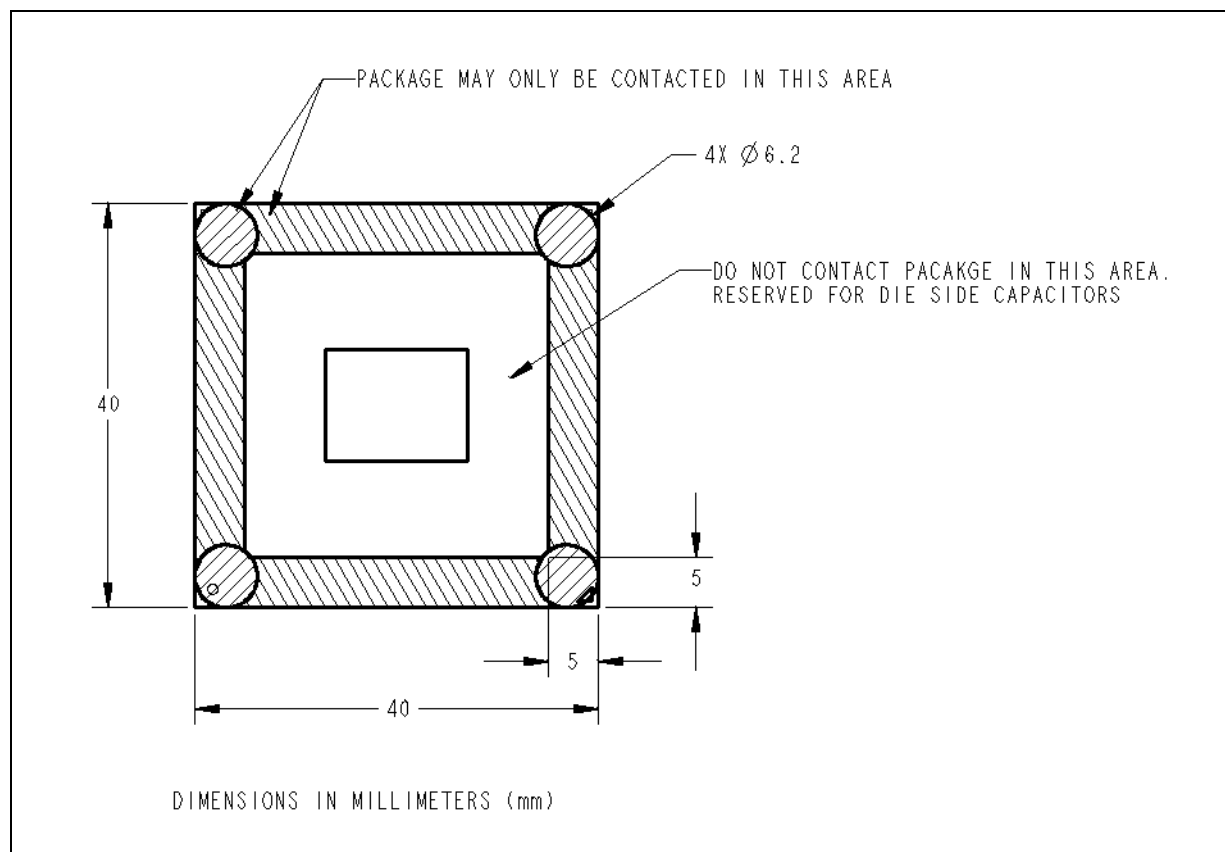
Parameter	Maximum	Notes
T _{CASE}	105° C	This temperature is measured at the geometric center of the package, refer to Section 7.0 .

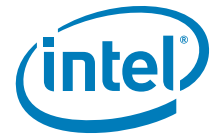
4.0 Mechanical Specifications

4.1 Package Keep-Out Zones Requirements

The heat sink must not touch the package in the areas shown in Figure 6. However, the heat sink should include a means to prevent the heat sink from forming an electrical short with the capacitors placed on the top side of the package. The reference thermal solution includes a electrically insulated foam gasket that aids in preventing the heat sink from tilting and coming in contact with the die side capacitors. The package substrate should not be used as a load bearing structure for the thermal solution during shock and vibe events. However, it is ok to have a foam gasket come in contact with the substrate to prevent die tilt as mentioned above.

Figure 6. Package Keep-Out Zone Requirements





4.2 Board Level Keep-Out Zone Requirements

A general description of the keep-out zones and mounting hole pattern for the reference thermal solutions are shown in [Appendix B, "Mechanical Drawings"](#). When using heat sinks that extend beyond the Intel® 3100 Chipset, refer to heat sink envelopes shown in [Figure 20](#). Motherboard components placed between the underside of the heat sink and motherboard cannot exceed 2.286 mm [0.090 in.] in height.

4.3 Maximum Allowable Static Force

The Intel® 3100 Chipset uses a FCBGA package with the back side of the die exposed. The backside of the die is the interface with the thermal solution. Since the die will come in contact with the thermal solution it is important to take precautions to avoid damaging the die or edges of the die. During thermal solution installation it is very important to avoid tilting the thermal solution and putting pressure on the edge of the die.

The thermal solution for the Intel® 3100 Chipset shall not exceed a max static force of 15 lbf normal to the die. Any force larger than this could damage the device.

5.0 Thermal Solution Requirements

5.1 Characterizing the Thermal Solution Requirement

The idea of a “thermal characterization parameter” Ψ (the Greek letter psi), is a convenient way to characterize the performance needed for the thermal solution and to compare thermal solutions in identical situations (i.e., heating source, local ambient conditions, etc.). The thermal characterization parameter is calculated using total package power, whereas actual thermal resistance, θ (theta), is calculated using actual power dissipated between two points. Measuring actual power dissipated into the heat sink is difficult, since some of the power is dissipated via heat transfer into the package and board.

The case-to-local ambient thermal characterization parameter (Ψ_{CA}) is used as a measure of the thermal performance of the overall thermal solution. It is defined by Equation 1 and measured in units of °C/W.

Equation 1. Case-to-Local Ambient Thermal Characterization Parameter (Ψ_{CA})

$$\Psi_{CA} = \frac{T_{CASE} - T_{LA}}{TDP}$$

The case-to-local ambient thermal characterization parameter, Ψ_{CA} , is comprised of Ψ_{CS} , the thermal interface material (TIM) thermal characterization parameter, and of Ψ_{SA} , the sink-to-local ambient thermal characterization parameter:

Equation 2. Case-to-Local Ambient Thermal Characterization Parameter (Ψ_{CA})

$$\Psi_{CA} = \Psi_{CS} + \Psi_{SA}$$

Ψ_{CS} is strongly dependent on the thermal conductivity and thickness of the TIM between the heat sink and device package.

Ψ_{SA} is a measure of the thermal characterization parameter from the bottom of the heat sink to the local ambient air. Ψ_{SA} is dependent on the heat sink material, thermal conductivity, and geometry. It is also strongly dependent on the air velocity through the fins of the heat sink. Figure 7 illustrates the combination of the different thermal characterization parameters.

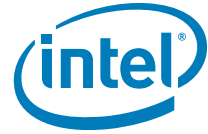
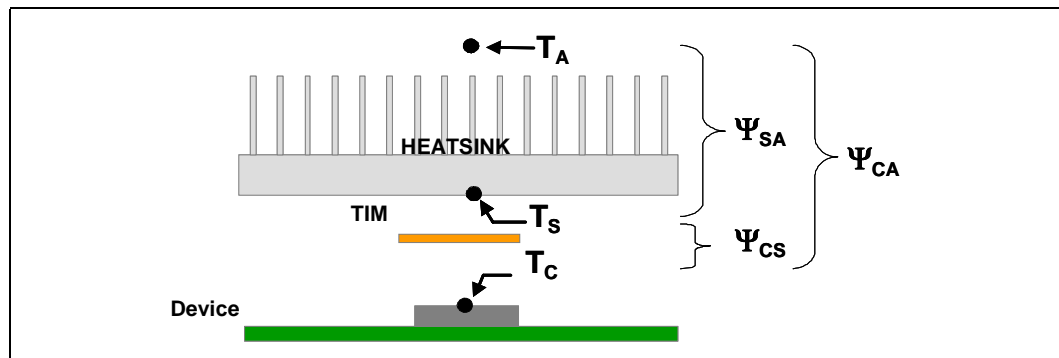


Figure 7. Processor Thermal Characterization Parameter Relationships



Example 1. Calculating the Required Thermal Performance

The cooling performance, Ψ_{CA} , is defined using the thermal characterization parameter previously described. The process to determine the required thermal performance to cool the device includes:

1. Define a target component temperature T_{CASE} and corresponding TDP.
2. Define a target local ambient temperature, T_{LA} .
3. Use [Equation 1](#) and [Equation 2](#) to determine the required thermal performance needed to cool the device.

The following provides an example of how you might determine the appropriate performance targets.

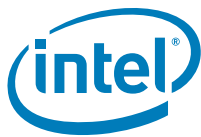
Assume:

- TDP = 10.4 W and $T_{CASE} = 105^{\circ}\text{C}$
- Local processor ambient temperature, $T_{LA} = 55^{\circ}\text{C}$.

Then the following could be calculated using [Equation 1](#) for the given chipset configuration:

$$\Psi_{CA} = \frac{T_{CASE} - T_{LA}}{TDP} = \frac{105 - 55}{10.4} = 4.81^{\circ}\frac{\text{C}}{\text{W}}$$

To determine the required heat sink performance, a heat sink solution provider would need to determine Ψ_{CS} performance for the selected TIM and mechanical load configuration. If the heat sink solution were designed to work with a TIM material performing at $\Psi_{CS} \leq 0.35^{\circ}\text{C/W}$, solving from [Equation 2](#), the performance needed from the heat sink is:



$$\Psi_{SA} = \Psi_{CA} - \Psi_{CS} = 4.81 - 0.35 = 4.46^{\circ}\frac{C}{W}$$

If the local ambient temperature is relaxed to 40° C, the same calculation can be carried out to determine the new case-to-ambient thermal resistance:

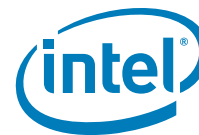
$$\Psi_{CA} = \frac{T_C - T_{LA}}{TDP} = \frac{105 - 40}{10.4} = 6.25^{\circ}\frac{C}{W}$$

It is evident from the above calculations that a reduction in the local ambient temperature has a significant effect on the case-to-ambient thermal resistance requirement. This effect can contribute to a more reasonable thermal solution including reduced cost, heat sink size, heat sink weight, and a lower system airflow rate.

Table 5 summarizes the thermal budget required to adequately cool the Intel® 3100 Chipset in one configuration using a TDP of 10.4 W. Further calculations would need to be performed for different TDPs. Since the results are based on air data at sea level, a correction factor would be required to estimate the thermal performance at other altitudes.

Table 5. Required Heat Sink Thermal Performance (Ψ_{CA})

Device	Ψ_{CA} (° C/W) at $T_{LA} = 40^{\circ}\text{C}$	Ψ_{CA} (° C/W) at $T_{LA} = 55^{\circ}\text{C}$
Intel® 3100 Chipset @ 10.4 W	6.25	4.81



6.0 Reference Heat Sinks

Intel has developed reference heat sinks designed to meet the cooling needs of the Intel® 3100 Chipset in embedded form factor applications. This chapter describes the overall requirements for the reference thermal solution including critical-to-function dimensions, operating environment, and verification criteria. This document details solutions that are compatible with the AdvancedTCA* and larger form factors. An additional design is shown for small form factors. The heat sink designs are not suitable for natural convection cooling and require a prescribed amount of system airflow. The system designer must ensure that suitable airflow is provided when using the reference heat sinks. A third party active heat sink (fan included) is available. [Appendix A, "Thermal Solution Component Suppliers"](#) contains vendor information for each component.

The heat sinks are attached to the board using a wire clip with each end hooked through an anchor soldered to the board. [Figure 8](#) illustrates an example of the thermal solution assembly. Detailed mechanical drawings of the heat sinks and clip are provided in [Appendix B, "Mechanical Drawings"](#).

6.1 AdvancedTCA* Reference Heat Sink

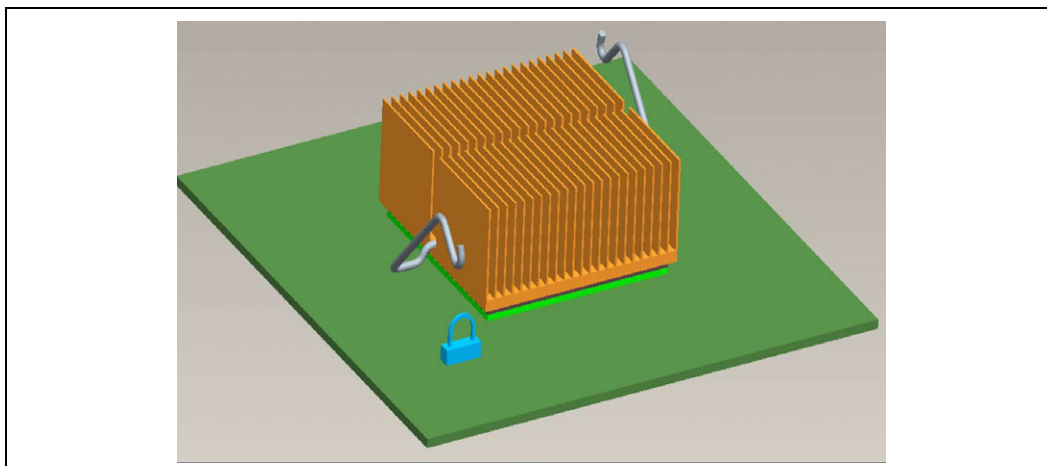
This reference heat sink is compatible with the AdvancedTCA* and larger (i.e., 1U) form factors. [Figure 9](#) demonstrates the heat sink thermal performance at various airflow rates. [Equation 1](#) and [Equation 2](#) can be used to determine the acceptable ambient temperature range for this heat sink.

6.1.1 Mechanical Design

The reference heat sink is shown in [Figure 8](#). The maximum heat sink height is constrained to 18.47 mm which enables use in most embedded form factors. The heat sink uses the torsional clip assembly (refer to [Section 6.4](#)) to mount to the PCB. Detailed drawings of this heat sink are provided in the [Appendix B, "Mechanical Drawings"](#).

The bottom surface of the heat sink includes a pedestal that interfaces with the top surface of the die. The pedestal is intended to provide clearance for capacitors placed on the top surface of the substrate. In addition, a foam gasket is attached to the heat sink's bottom surface to prevent the heat sink from tilting on the die. In rare occurrences, the heat sink could tilt and short with the capacitors if the gasket was not included. Other methods to prevent the heat sink base from shorting with the die side capacitor's can also be used, such as placing an electrically insulated material between the capacitors and heat sink base. The geometry of the pedestal and gasket are contained in the detailed drawings in [Appendix B, "Mechanical Drawings"](#).

Figure 8. AdvancedTCA* Reference Heat Sink Assembly



6.1.2 Keep-Out Zone Requirements

The required board keep-out zones are shown in [Appendix B, “Mechanical Drawings”](#)

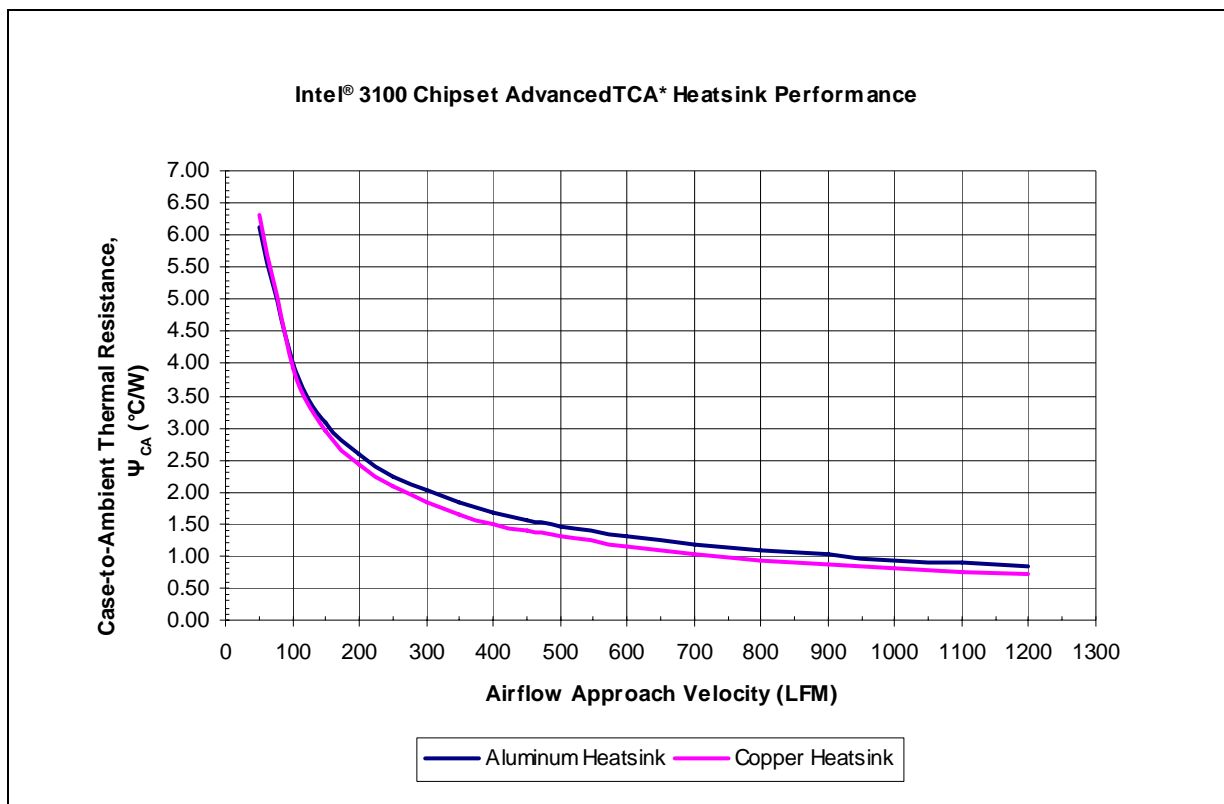
6.1.3 Thermal Performance

The reference heat sink can be fabricated from either copper or aluminum. The copper version provides the best cooling, while the aluminum version cost less. Depending on the boundary conditions, both heat sinks can meet the thermal performance needed to cool the Intel® 3100 Chipset in the AdvancedTCA* form factor. The heat sink performance versus airflow velocity is shown in [Figure 9](#). The heat sink may be used in other form factors that can provide the required amount of airflow to meet the components thermal specifications.

The system integrator can make trade-offs to determine the best heat sink material to use based on usage conditions. For example, a higher ambient temperature might be considered with use of the copper heat sink [$T_{LA} = T_{CASE} - (\Psi_{CA}) \times (TDP)$].



Figure 9. Reference Heat Sink, AdvancedTCA* Form Factor: Thermal Performance vs. Airflow



6.2 Small Form Factor Reference Heat Sink

This reference heat sink is compatible with smaller embedded form factors (i.e., CompactPCI* and AdvancedMC*). [Figure 11](#) demonstrates the heat sink thermal performance at various volumetric airflow rates. [Equation 1](#) and [Equation 2](#) can be used to determine the acceptable ambient temperature range that this heat sink can be used.

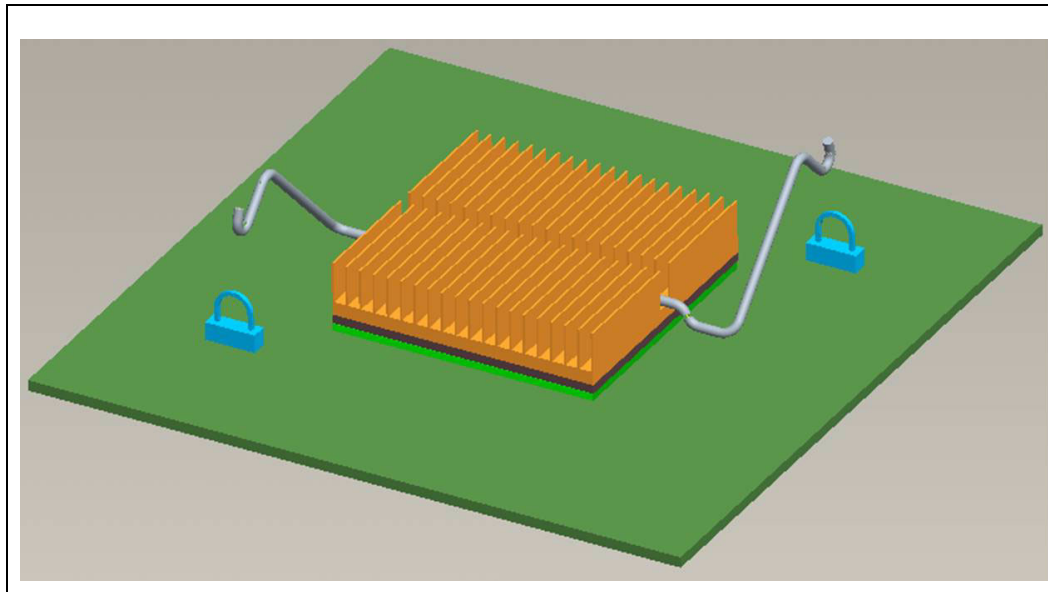
6.2.1 Mechanical Design

The small form factor reference thermal solution is shown in [Figure 10](#). The heat sink fits within the volumetric keep-out zone outlined in [Appendix B, "Mechanical Drawings"](#). The maximum heat sink is constrained to 8.49 mm which enables use in common small form factors such as Compact PCI* and the AdvancedMC* (mezzanine card). The heat sink uses the torsional clip assembly (refer to [Section 6.4](#)) to mount to the PCB. Detailed drawings of this heat sink are provided in [Appendix B, "Mechanical Drawings"](#).

The bottom surface of the heat sink includes a pedestal that interfaces with the top surface of the die. The pedestal is intended to provide clearance for capacitors placed on the top surface of the substrate. In addition, a foam gasket is included on the heat sink's bottom surface to prevent the heat sink from tilting. In rare occurrences, the heat sink could tilt over and short with the capacitors if the gasket is not included. Other methods to prevent the heat sink base from shorting with the die side capacitor's

can also be used, such as placing an electrically insulated material between the capacitors and heat sink base. The geometry of the pedestal and foam gasket are contained in the detailed drawings in [Appendix B, “Mechanical Drawings”](#).

Figure 10. Small Form Factor Reference Heat Sink Assembly



6.2.2 Additional Keep-Out Zone Requirements

The volumetric constraints for this heat sink are shown in [Appendix B, “Mechanical Drawings”](#)

6.2.3 Thermal Performance

The small form factor reference heat sink can be fabricated from either copper or aluminum. The copper version provides the best cooling while the aluminum version cost less. Based on the boundary conditions, both versions can meet the thermal performance needed to cool the Intel® 3100 Chipset.

The system integrator can make trade-offs to determine the best heat sink material to use based on usage conditions. For example, a higher ambient temperature might be considered with use of the copper heat sink $[T_{LA} = T_{CASE} - (\Psi_{CA}) \times (TDP)]$.

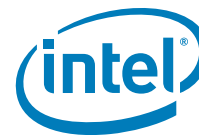
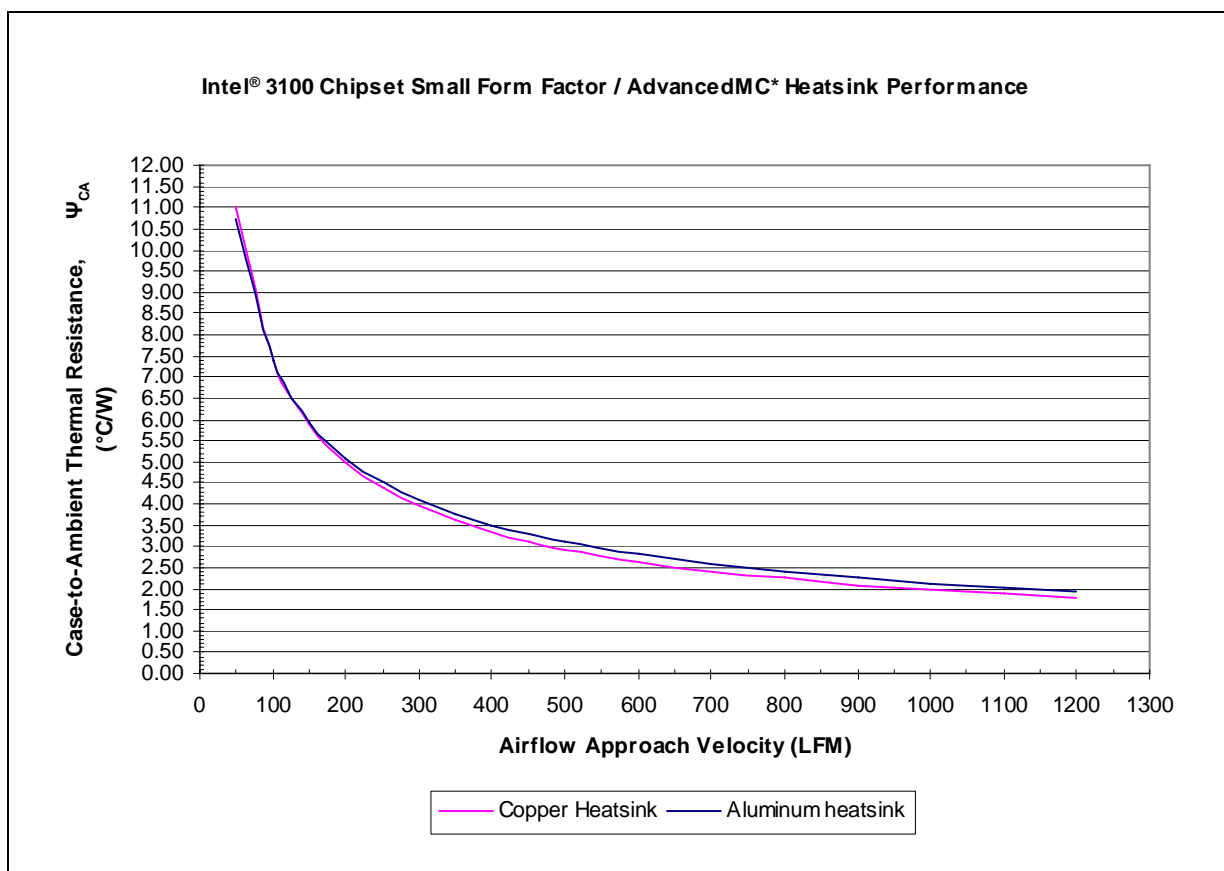


Figure 11. Reference Heat Sink, Small Form Factor: Thermal Performance vs. Airflow



6.3 Active Heat Sink

An active heat sink that meets the thermal and mechanical requirements is available from third party vendors. The heat sink is suitable for benchtop use as well as other applications where system airflow is not available. The contact information for third party active heat sinks is available in [Appendix A, "Thermal Solution Component Suppliers"](#).

6.3.1 Mechanical Design

The active heat sink must fit within the volumetric keep-out zone outlined in [Appendix B, "Mechanical Drawings"](#). The heat sink should use the torsional clip assembly (refer to [Section 6.4](#)) to mount to the PCB.

6.3.2 Additional Keep-Out Zone Requirements

There are no other volumetric constraints required for the active heat sinks referenced in [Appendix B, "Mechanical Drawings"](#). However, if a different active heat sink is used, the board designers must ensure that any other keep-out requirements are addressed.



6.4 Torsional Clip

The reference solutions use wire clips with hooked ends. The hooks attach to wire anchors that fasten the clip to the board. The torsional clip is shown in [Figure 8](#) and [Figure 10](#). Refer to the detailed mechanical drawings in [Appendix B, “Mechanical Drawings”](#) for more information.

6.5 Solder-Down Anchors

The torsional clip uses a solder-down anchor to attach to the board. It is based on a standard three-pin jumper and is soldered to the board like any common through-hole header. The anchor design includes 45° bent leads to increase the anchor attach reliability over time. See [Appendix A, “Thermal Solution Component Suppliers”](#) for the part number and supplier information.

6.6 Heat Sink Orientation

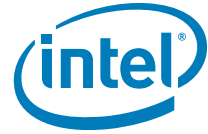
Since the thermal solutions are based on unidirectional heat sinks, airflow direction must be aligned with the direction of the fins of the heat sink. [Figure 8](#) and [Figure 10](#) illustrate the orientation of the package, solder-down anchors, and heat sink relative to the system airflow.

6.7 Thermal Interface Material (TIM)

The thermal interface material provides improved conductivity between the die and heat sink. It is important to understand and consider the impact of the interface between the die and heat sink base to the overall thermal solution. Specifically, the bond line thickness, interface material area, and interface material thermal conductivity must be selected to optimize the thermal solution.

It is important to minimize the thickness of the thermal interface material, commonly referred to as the bond line thickness. A large gap between the heat sink base and the die yields a greater thermal resistance. The thickness of the gap is determined by the flatness of both the heat sink base and the die, plus the thickness of the thermal interface material, and the clamping force applied by the heat sink attachment method. To ensure proper and consistent thermal performance, the TIM and application process must be properly designed.

The Intel® 3100 Chipset reference thermal solutions uses Honeywell* PCM45F. Alternative materials can be used at your discretion. Regardless, the entire heat sink assembly, including the heat sink, and TIM (including attachment method), must be validated together for specific applications.



7.0 Thermal Metrology

The system designer must make measurements to accurately determine the performance of the thermal solution. The heat sink designs should be validated using a thermal test vehicle. The thermal test vehicle is a device that simulates the thermal characteristics of the Intel® 3100 Chipset. It is also recommended to perform a final verification test of the heat sink with an actual Intel® 3100 Chipset in a real working environment.

This section provides guidelines on techniques to perform thermal tests including:

- [Section 7.1](#): Guidelines on how to accurately measure the component temperature.
- [Section 7.2](#): Details the use of the thermal test vehicle.
- [Section 7.3](#): Information on running a power simulation software that will emulate anticipated thermal design powers on an actual Intel® 3100 Chipset.

7.1 Die Temperature Measurements

The component T_{CASE} must be maintained at or below the maximum temperature specification as noted in [Table 4](#). The surface temperature at the geometric center of the die corresponds to T_{CASE} . Measuring T_{CASE} requires special care to ensure an accurate temperature measurement.

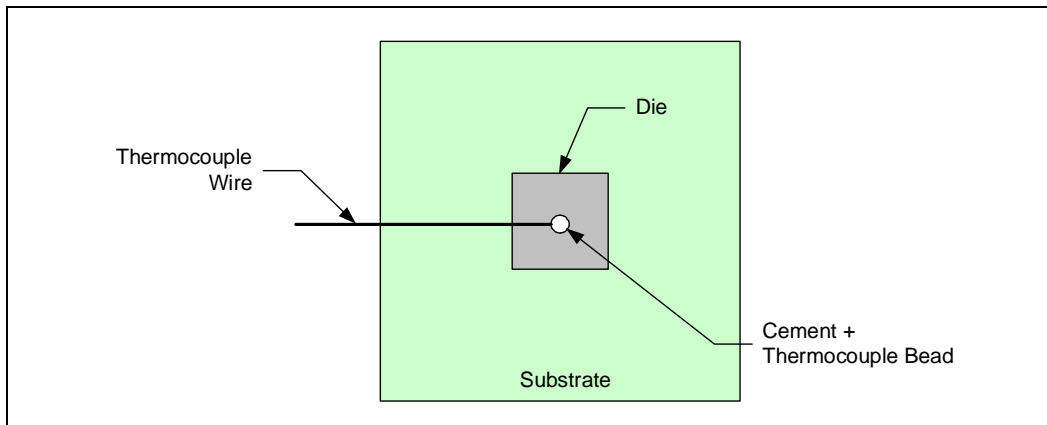
Temperature differences between the temperature of a surface and the surrounding local ambient air can introduce errors in the measurements. The measurement errors could be due to a poor thermal contact between the thermocouple junction and the surface of the package, heat loss by radiation and/or convection, conduction through thermocouple leads, or contact between the thermocouple attachment epoxy and the heat sink base. To maximize measurement accuracy, only the 0° attach approach described below should be used to attach the thermocouple.

7.1.1 0 Degrees Angle Thermocouple Attach Methodology

1. Mill a 3.3 mm (0.13 in.) diameter and 1.5 mm (0.06 in.) deep hole centered on the bottom of the heat sink base.
2. Mill a 1.3 mm (0.05 in.) wide and 0.5 mm (0.02 in.) deep slot from the centered hole to one edge of the heat sink (see [Figure 12](#)).
3. Attach thermal interface material to the bottom of the heat sink base.
4. Cut out portions of the TIM to make room for the thermocouple wire and bead. The cutouts should match the slot and hole milled into the heat sink base.
5. Attach a 36 gauge or smaller calibrated K-type thermocouple bead or junction to the center of the top surface of the die using a high thermal conductivity cement. During this step, ensure no contact is present between the thermocouple cement and the heat sink base because it may affect the thermocouple reading. **It is critical that the thermocouple bead makes contact with the die** (see [Figure 12](#)).

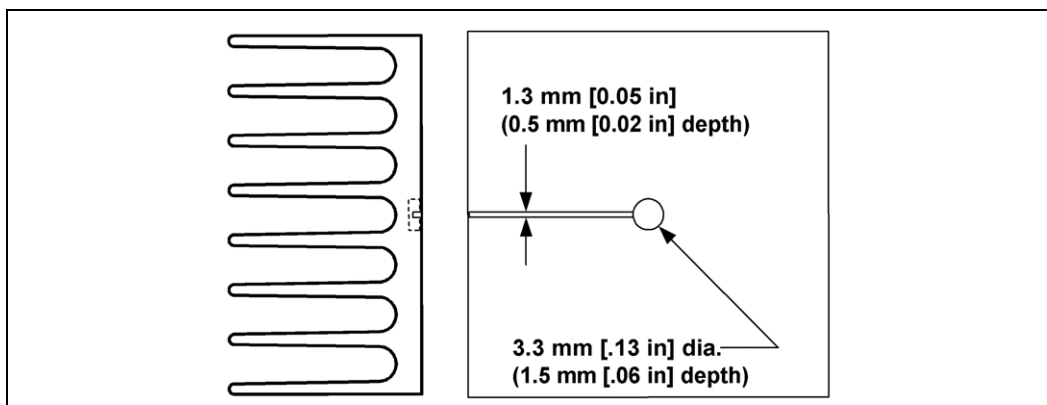
6. Attach the heat sink assembly to the Intel® 3100 Chipset and route thermocouple wires out through the milled slot.

Figure 12. 0 Degrees Angle Attach Methodology (Top View)



Note: Not to scale.

Figure 13. 0 Degrees Angle Attach Heat Sink Modifications

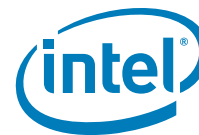


Note: Not to scale.

7.2 Thermal Test Vehicle (TTV)

The thermal test vehicle (TTV) is designed to simulate the thermal characteristics of the Intel® 3100 Chipset. However, the device is not a functional Intel® 3100 Chipset. The TTV uses a custom test board provided with the TTV. The power into the device can be accurately controlled to ensure that you are dissipating the correct amount of power for thermal solution validation. Using the method described in [Figure 7.1](#), the thermal performance of the heat sink can be determined.

Contact your Intel Field representative for more information about the thermal test vehicle.



7.3 Power Simulation Software

The power simulation software is a utility designed to dissipate the thermal design power on the Intel® 3100 Chipset. To assess the thermal performance of the Intel® 3100 Chipset thermal solution under “worst-case realistic application” conditions, Intel has developed a software utility that operates the product at near worst-case realistic power dissipation. Contact your Intel Field representative to obtain the maximum power program for the Intel® 3100 Chipset.



8.0 Reliability Guidelines

Each motherboard, heat sink, and attach combination may vary the mechanical loading of the component. The user should carefully evaluate the reliability of the completed assembly prior to use in high volume. Some general recommendations are shown in Table 6.

Table 6. Reliability Requirements

Test ⁽¹⁾	Requirement	Pass/Fail Criteria ⁽²⁾
Mechanical Shock	50 g, board level, 11 msec, 3 shocks/axis	Visual Check and Electrical Functional Test
Random Vibration	7.3 g, board level, 45 min/axis, 50 Hz to 2000 Hz	Visual Check and Electrical Functional Test
Temperature Life	85° C, 2000 hours total, checkpoints at 168, 500, 1000, and 2000 hours	Visual Check
Thermal Cycling	-5° C to +70° C, 500 cycles	Visual Check
Humidity	85% relative humidity, 55° C, 1000 hours	Visual Check

Notes:

1. The above tests should be performed on a sample size of at least 12 assemblies from three lots of material.
2. Additional Pass/Fail Criteria may be added at the discretion of the user.



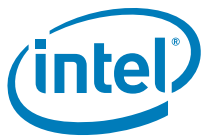
Appendix A Thermal Solution Component Suppliers

A.1 Reference Heat Sink

Table 7. Reference Heat Sink

Part	Intel Part Number	Supplier (Part Number)	Contact Information
AdvancedTCA* and Embedded Form Factor Heat Sink	N/A	ECB-00307-01-GP (Copper) ECB-00306-01-GP (Aluminum)	Wendy Lin 510-770-8566, x211 Wendy@coolermaster.com
Small Form Factor Heat Sink	N/A	ECB-00304-01-GP (Aluminum) ECB-00305-01-GP (Copper)	Wendy Lin 510-770-8566, x211 Wendy@coolermaster.com
Active Heat Sink	N/A	ECB-00208-03	Wendy Lin 510-770-8566, x211 Wendy@coolermaster.com
Thermal Interface PCM45F	N/A	Honeywell* (PCM45F)	Paula Knoll 858-705-1274 paula.knoll@honeywell.com
Heat Sink Attach Clip	A69230-001	CCI/ACK*	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
		Foxconn*	Bob Hall (USA) 503-693-3509, x235 bhall@foxconn.com
Solder-Down Anchor	A13494-005	Foxconn (HB96030-DW)	Julia Jiang (USA) 408-919-6178 julij@foxconn.com

Note: The enabled components may not be currently available from all suppliers. Contact the supplier directly to verify time of component availability.



Appendix B Mechanical Drawings

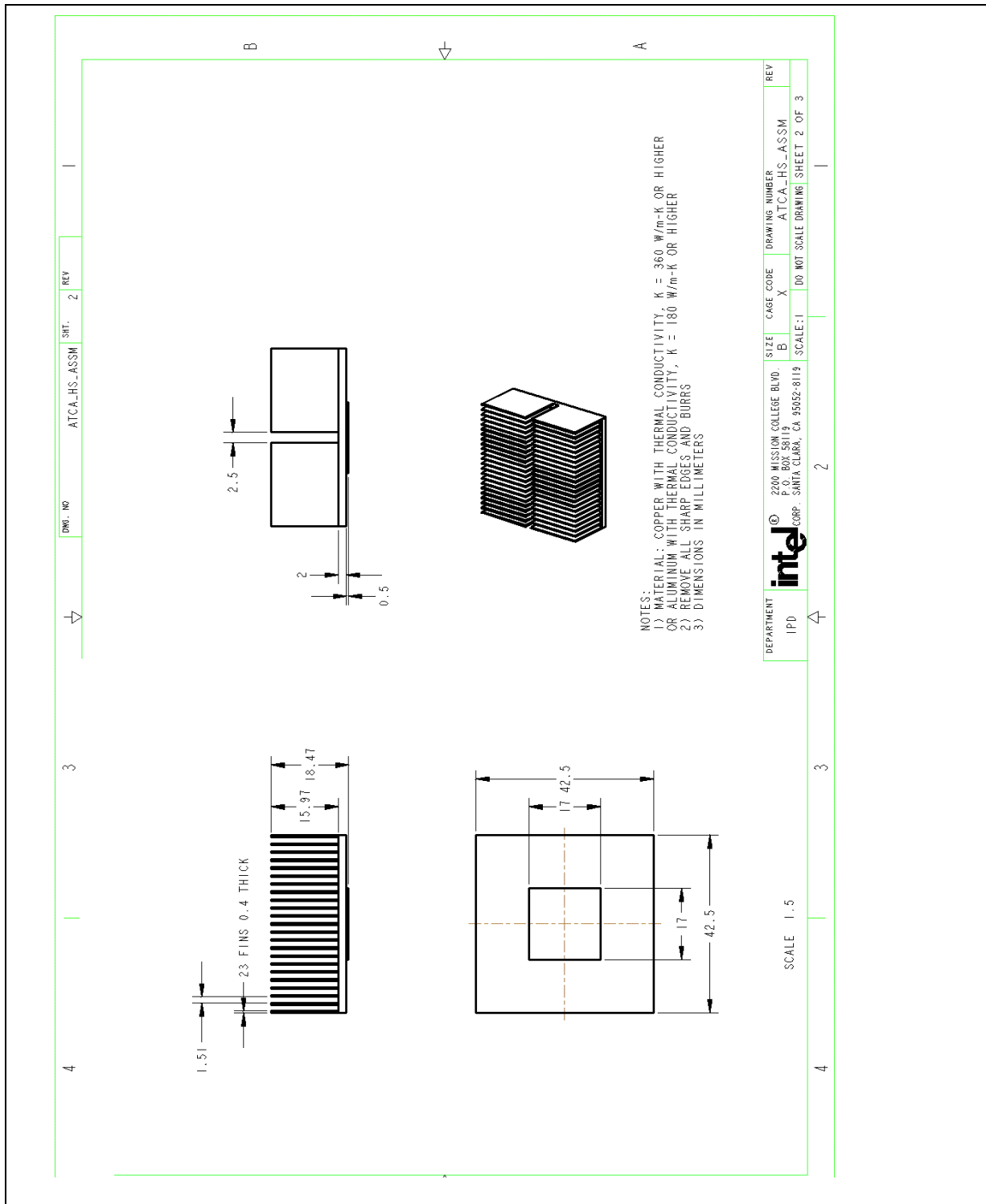
Table 8 lists the mechanical drawings included in this appendix.

Table 8. Mechanical Drawing List

Description	Figure Number
AdvancedTCA* Reference Heat Sink Assembly Drawing	14
AdvancedTCA* Reference Heat Sink Drawing	15
Heat Sink Foam Gasket Drawing	16
Torsional Clip Drawing	17
Small Form Factor Reference heat sink Assembly Drawing	18
Small Form Factor Reference Heat Sink Drawing	19
Passive Reference Heat Sink PCB Keep-Out Zone Requirements	20
Active Heat Sink PCB Keep-Out Zone Requirements	21
Passive and Active Heat Sink PCB Keep-Out Zone Requirements	22

[illegible]

Figure 15. AdvancedTCA* Reference Heat Sink Drawing



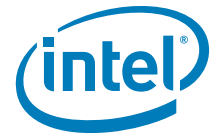


Figure 16. Heat Sink Foam Gasket Drawing

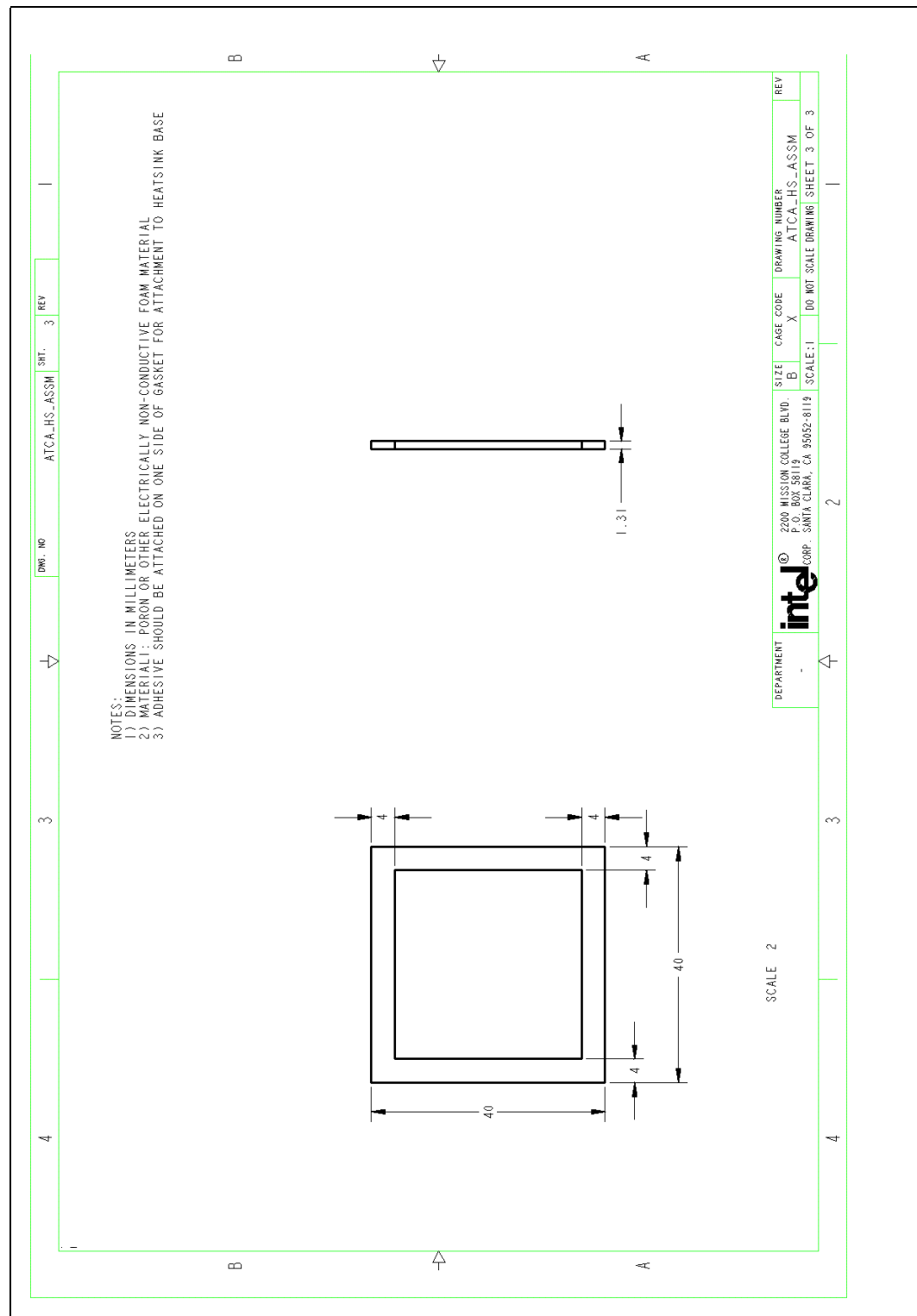
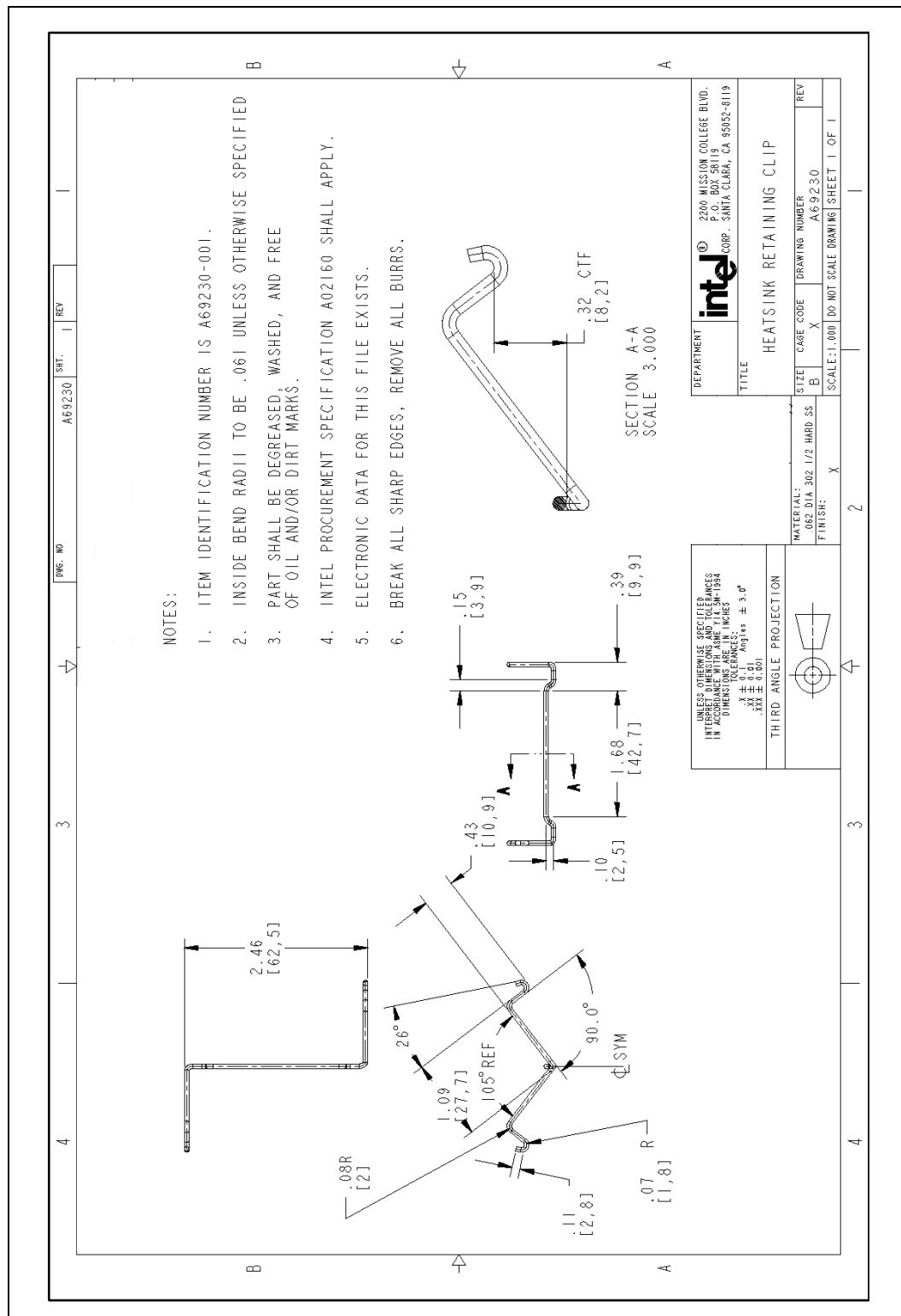


Figure 17. Torsional Clip Drawing



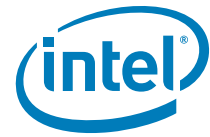


Figure 18. Small Form Factor Reference heat sink Assembly Drawing

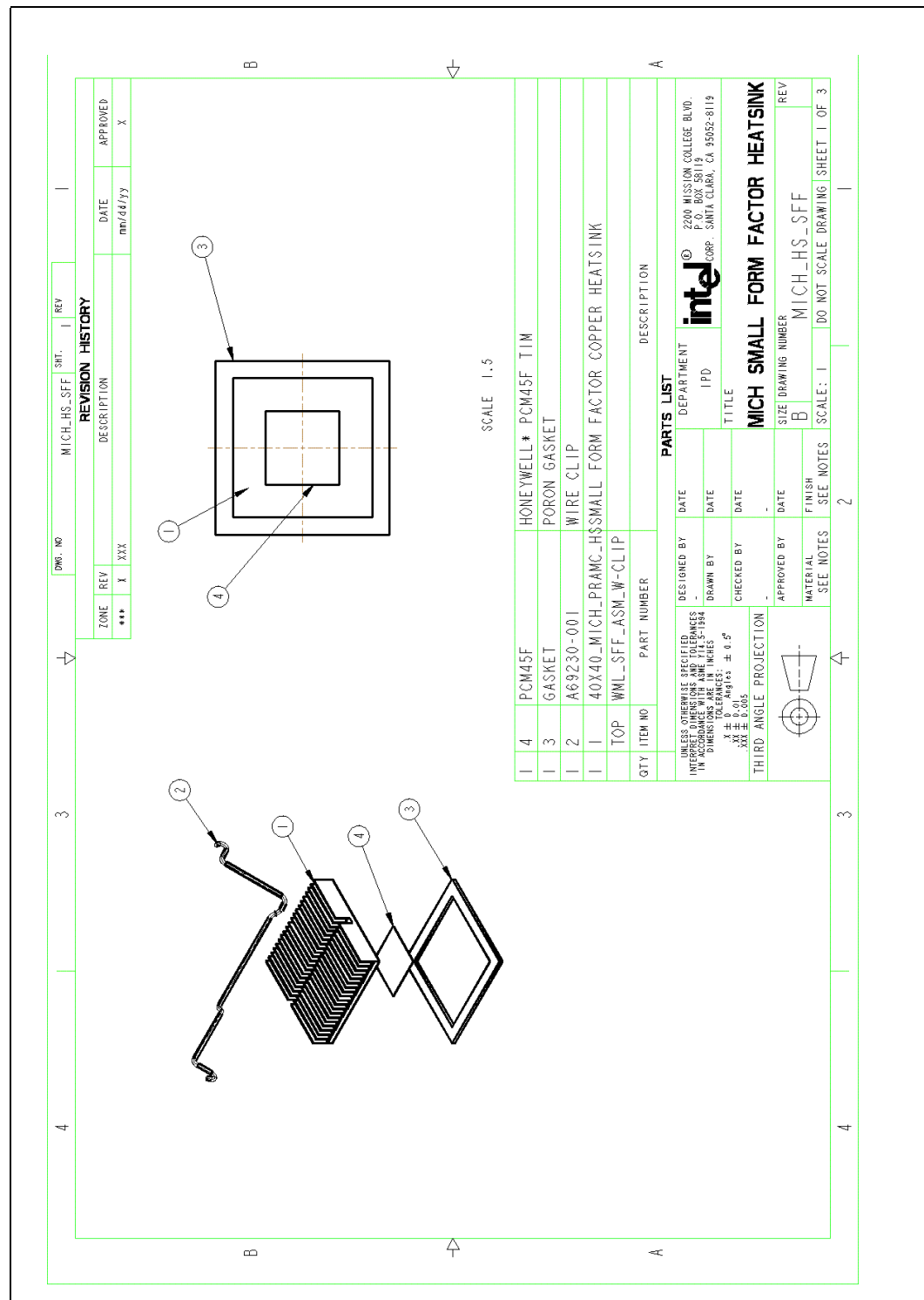
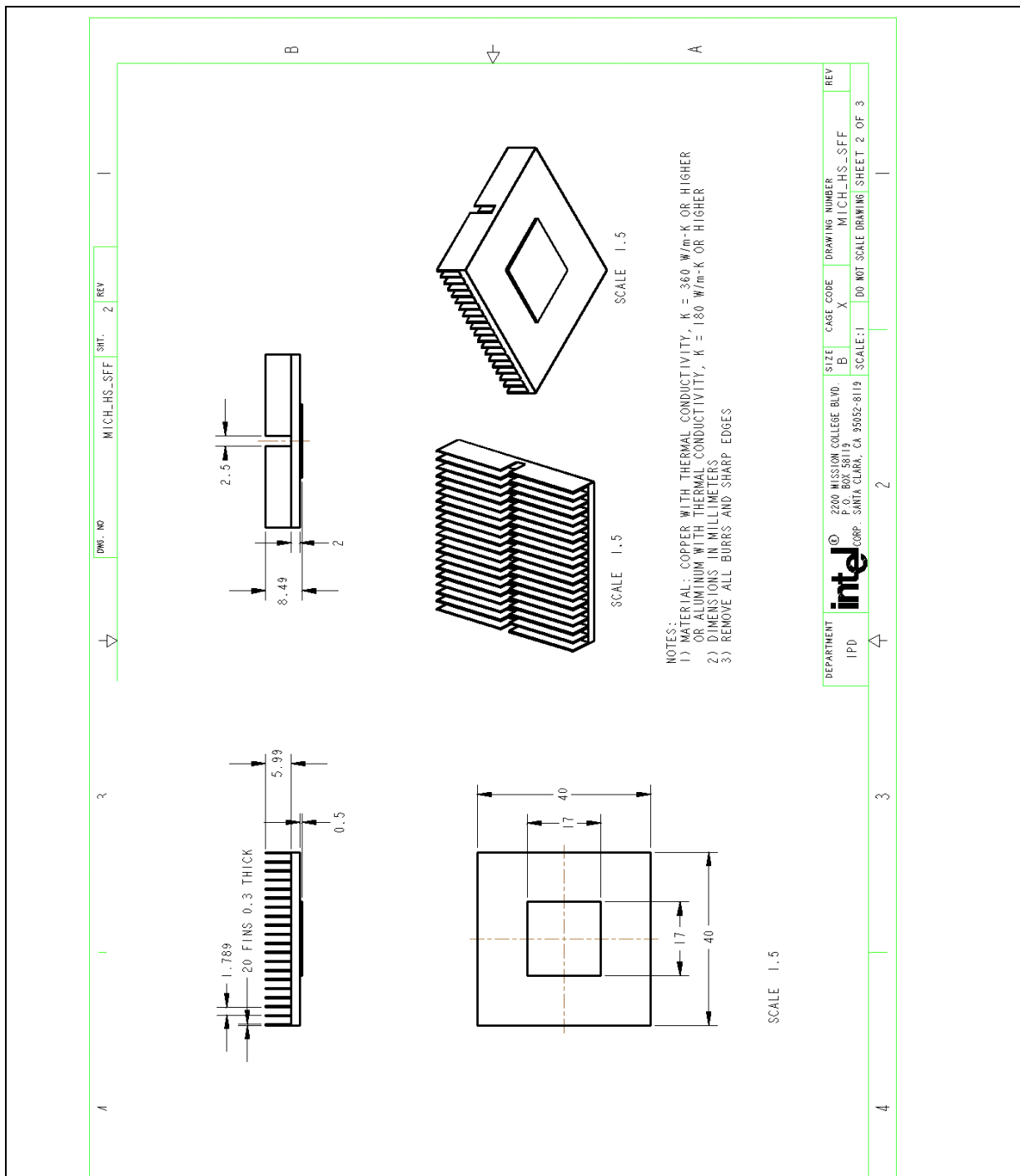


Figure 19. Small Form Factor Reference Heat Sink Drawing



Top View Dimensions:

- Overall width: 8.763 [1.35]
- Overall height: 22.758 [1.90]
- Top edge features: 1.524 [1.06], 5.715 [1.23], 2.54 [1.10], 4.318 [1.17]
- Bottom edge features: 2X 27.46 [1.08], 2X 28.156 [1.11], 2X 30.455 [1.20]
- Internal features: 48.104 [1.93], 49.104 [1.93], 56.312 [1.22], 40 [1.57]
- Section lines: 2X 27.46 [1.08], 2X 28.156 [1.11], 2X 30.455 [1.20]

Detail A Dimensions:

- Overall width: 8.763 [1.35]
- Overall height: 22.758 [1.90]
- Top edge features: 1.524 [1.06], 5.715 [1.23], 2.54 [1.10], 4.318 [1.17]
- Bottom edge features: 2X 27.46 [1.08], 2X 28.156 [1.11], 2X 30.455 [1.20]
- Internal features: 48.104 [1.93], 49.104 [1.93], 56.312 [1.22], 40 [1.57]
- Section lines: 2X 27.46 [1.08], 2X 28.156 [1.11], 2X 30.455 [1.20]

Detail B Dimensions:

- Overall width: 8.763 [1.35]
- Overall height: 22.758 [1.90]
- Top edge features: 1.524 [1.06], 5.715 [1.23], 2.54 [1.10], 4.318 [1.17]
- Bottom edge features: 2X 27.46 [1.08], 2X 28.156 [1.11], 2X 30.455 [1.20]
- Internal features: 48.104 [1.93], 49.104 [1.93], 56.312 [1.22], 40 [1.57]
- Section lines: 2X 27.46 [1.08], 2X 28.156 [1.11], 2X 30.455 [1.20]

Legend:

- 2.54 MM (.100") COMPONENT KEEPOUT.
- 1.778 MM (.070") MOTHERBOARD COMPONENT KEEPOUT.
- TRACE KEEPOUT.
- NO MOTHERBOARD COMPONENT PLACEMENT ALLOWED.

Figure 21. Active Heat Sink PCB Keep-Out Zone Requirements

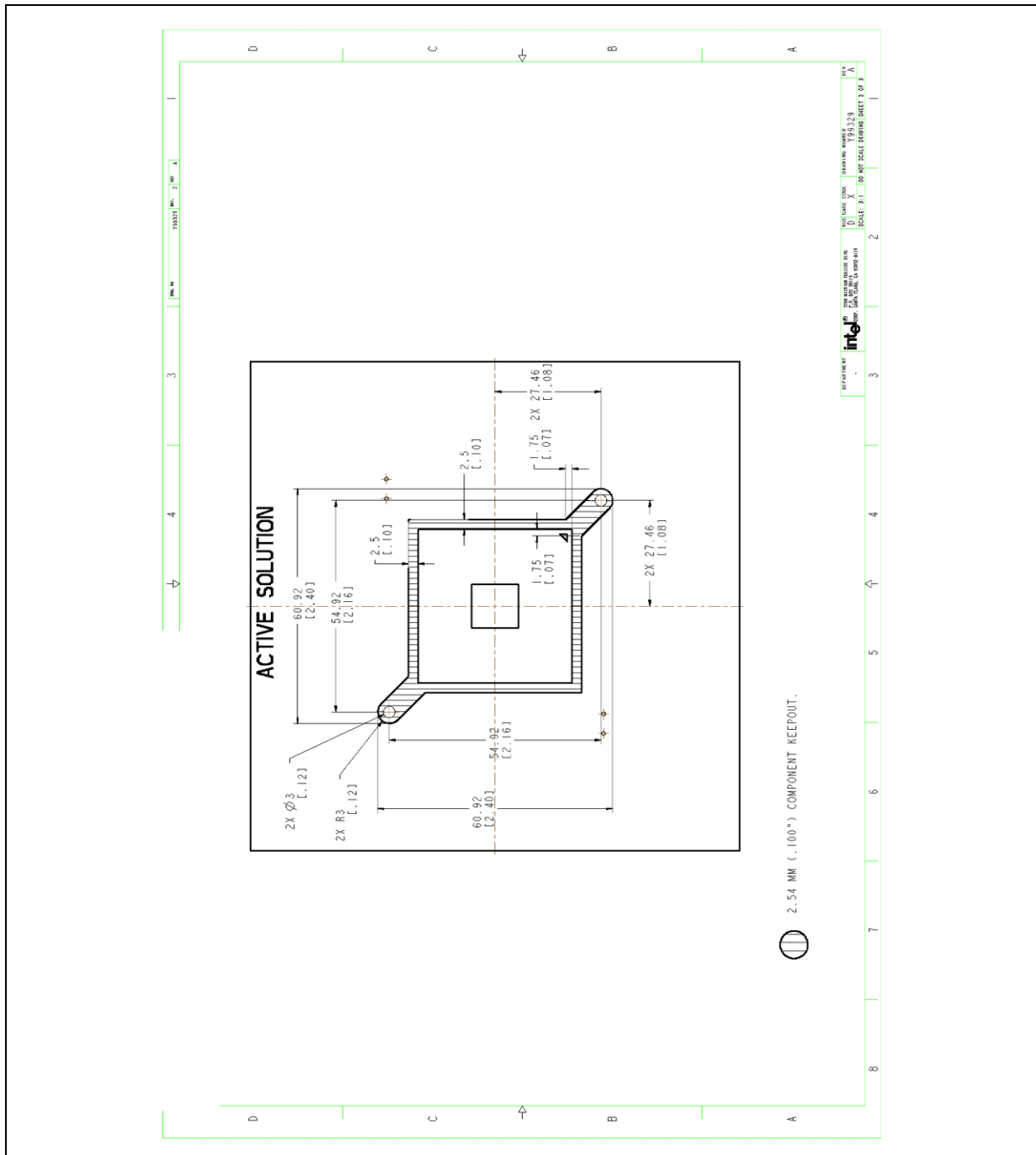


Figure 22. Passive and Active Heat Sink PCB Keep-Out Zone Requirements

